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SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 09/655,847
Filing Date: September 06, 2000
Appellant(s): ISHII ET AL.

Michael K. Mutter
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed November 17, 2006 appealing from the Office action mailed November 23, 2005.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

WITHDRAWN REJECTIONS

The following grounds of rejection are not presented for review on appeal because they have been withdrawn by the examiner.

The claim rejection under 35 USC 102(e) based on Arai (USP 6,527,642) has been withdrawn as noted in the Advisory Action of April 21, 2006.

The claim rejection under 35 USC 103(a) based on Kamimura (JP 60-191758) in view of Eda et al. (USP 6,044,723) is withdrawn.

NEW GROUND(S) OF REJECTION

Claims 1-4, 7, 9-12, and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Eda et al. (USP 6,044,723) in view of Kamimura (JP 60-191758).

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

JP 60-191758	Kamimura	12/1985
USP 6,044,723	Eda et al.	4/2000

(9) Grounds of Rejection

> The following ground(s) of rejection are applicable to the appealed claims:

NEW GROUND(S) OF REJECTION

QWG 3/19/04

Claims 1-4, 7, 9-12, and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Eda et al. (USP 6,044,723) in view of Kamimura (JP 60-191758).

Eda et al. teaches a power steering apparatus having: an electric motor (21) for steering assistance; a worm shaft (30) on which a worm is disposed; a steering shaft (2,3), configured to engage a steering wheel, on which a worm wheel (13) is disposed and to which a rotary motion of said electric motor is transmitted through said worm shaft, and an interlocking member for connecting the motor shaft to the worm shaft (for example, see Figure 13A). Referring to column 1, lines 25-42, Eda et al. discloses the importance of setting the proper backlash between the worm and the worm wheel. For example, when the backlash is too small, the teeth mesh so tightly that the operational torque is increased. Alternatively, when the backlash is too great, undesirable noise is created by the teeth of the worm hitting the teeth of the worm wheel. Eda et al. clearly

identifies the importance of providing the proper backlash between worm gears of a steering device.

Eda et al. does not teach the claimed biasing arrangement for biasing the worm gears together so as to provide the proper backlash between gears. However, it was known in the art to use a biasing device for setting the backlash between worm gears.

For example, Figure 1 of Kamimura teaches a gear arrangement for solving problems of backlash generation between worm gears and the fluctuation of torque required to turn the worm gears. Specifically, Kamimura teaches a worm (23) engaging a worm gear (22), a biasing spring member (48) biasing, via a bearing (43), said worm shaft toward said worm wheel, a cylindrical bore accepting said bearing, the cylindrical bore defining a first concave member, a second concave member (41) accepting the spring biasing member, and a housing (42) for housing said bearing and said concave members, wherein the biasing member is movably acceptable only toward the concave member. The concave member of Kamimura is integrally formed with the housing member in the same manner as the concave member (83) of the instant device is integrally formed with a housing member (8). Further, the biasing member (48) of Kamimura is movably acceptable only toward the concave member inasmuch as the biasing member (30) is movable only towards the concave member (83) of the instant device.

Alternatively, the adjustment screw (46) of Kamimura can be considered the claimed biasing member, wherein the adjustment screw (46) is movably acceptable only

toward the concave member inasmuch as the biasing member (30) is movable only towards the concave member (83) of the instant device.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the worm gear arrangement of Eda et al. with the mechanism for setting backlash taught by Kamimura, motivation being to prevent problems of backlash generation between worm gears and the fluctuation of torque required to turn the worm gears.

With respect to claims 3-4, Kamimura teaches the worm shaft being supported in a gear housing (21,44) having a tapped hole, and said biasing member includes a screw body (46) tightly fastened in said tapped hole and a spring body (48) interposed between said screw body and said worm shaft, wherein the biasing member (housing member 42) is in contact with the bearing which is disposed on the worm shaft.

With respect to claim 9, the housing member (42) directly holds the bearing (43) and holds the biasing spring (48).

With respect to claim 10, the Kamimura arrangement anticipates the claim language. Specifically, the gear housing (21) is formed with a bottom portion which contains the worm shaft (36), bearings (32,33,43), worm (23), and biasing arrangement (42,48). The bottom portion of the gear housing defines a concave member, inasmuch as the gear housing (8) of the instant device defines the concave member (83). Referring to Figure 1, Kamimura illustrates the concave member accepting the bearing (43), the worm (23), and the biasing member (42,48). Further, the spring biasing

member (48) is movably acceptable only toward the concave member and the bearing may be deflected into the concave member.

With respect to claim 14, the Kamimura reference can be interpreted in different ways so as to anticipate the claim language. For example, the housing member (42) having the concave member (41), the concave member accepting the biasing member (45,46), wherein a space is established between the concave member (41) and the biasing member (45,46), the biasing member (45,46) moves within the space to be accepted in the concave member.

(10) Response to Argument

Applicant argues that the examiner has not sufficiently identified the elements of the Kamimura reference by number to explain how the prior art reference was interpreted. This argument is moot because a new Grounds of Rejection is clearly set forth above, including a detailed description with reference numerals of how the prior art is being interpreted.

Independent Claim 7

Applicants argue the Final Rejection is unclear as to whether the examiner intended to modify the Kamimura reference with the teachings of the Eda reference, or to modify the Eda reference with the Kamimura reference. In response to this argument, a new grounds of rejection is set forth above.

Applicants argue (1)the examiner has not provided a reason for adding the Kamimura's biasing mechanism to Eda's power steering system, (2) that Eda fails to establish a motivation for modifying references, and (3) nothing in Eda suggests a need

to adjust the engagement of a worm with a worm wheel. These arguments are not persuasive for the following reasons. As noted above, Eda identifies the importance of setting the proper backlash between the worm and the worm wheel of a steering device. Referring to column 1, lines 25-42, Eda describes when the backlash between the worm gears is too small, the teeth mesh so tightly that the operational torque is increased. Alternatively, when the backlash is too great, undesirable noise is created by the teeth of the worm hitting the teeth of the worm wheel. The gear arrangement of Eda is configured to reduce the noise of the gears caused by an increased backlash. Accordingly, Eda clearly identifies the need for providing the proper backlash between the worm gears so as to limit gear noise and to prevent an increase in operating torque. Accordingly, it would have been within the skill of an engineer in the steering art to look to the teachings of the Kamimura reference for maintaining the proper backlash between worm gears.

Kamimura teaches a worm gear arrangement having means for solving the conventional problems of backlash generation between worm gears and the fluctuation in the torque required to turn the worm gear.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the worm gear arrangement of Eda et al. with the mechanism for setting backlash taught by Kamimura, motivation being to prevent problems of backlash generation between worm gears and the fluctuation of torque required to turn the worm gears.

Independent Claims 9 and 12

The new grounds of rejection set forth above clearly identifies how each component of the prior art anticipates the claim language, including the motivation for combining the prior art teachings.

Dependent Claims

The new grounds of rejection set forth above clearly identifies how each component of the prior art anticipates the claim language, including the motivation for combining the prior art teachings.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

This examiner's answer contains a new ground of rejection set forth in section **(9)** above. Accordingly, appellant must within **TWO MONTHS** from the date of this answer exercise one of the following two options to avoid *sua sponte* **dismissal of the appeal** as to the claims subject to the new ground of rejection:

(1) **Reopen prosecution.** Request that prosecution be reopened before the primary examiner by filing a reply under 37 CFR 1.111 with or without amendment,

affidavit or other evidence. Any amendment, affidavit or other evidence must be relevant to the new grounds of rejection. A request that complies with 37 CFR 41.39(b)(1) will be entered and considered. Any request that prosecution be reopened will be treated as a request to withdraw the appeal.

(2) **Maintain appeal.** Request that the appeal be maintained by filing a reply brief as set forth in 37 CFR 41.41. Such a reply brief must address each new ground of rejection as set forth in 37 CFR 41.37(c)(1)(vii) and should be in compliance with the other requirements of 37 CFR 41.37(c). If a reply brief filed pursuant to 37 CFR 41.39(b)(2) is accompanied by any amendment, affidavit or other evidence, it shall be treated as a request that prosecution be reopened before the primary examiner under 37 CFR 41.39(b)(1).

Extensions of time under 37 CFR 1.136(a) are not applicable to the TWO MONTH time period set forth above. See 37 CFR 1.136(b) for extensions of time to reply for patent applications and 37 CFR 1.550(c) for extensions of time to reply for ex parte reexamination proceedings.

Respectfully submitted,

William C. Joyce

William C. Joyce 3/18/07

A Technology Center Director or designee must personally approve the new ground(s) of rejection set forth in section (9) above by signing below:

John Weiss
Acting Director 3600

Conferees:

Meredith C. Petravick for TQAS

Richard W. Ridley

WORM-TYPE REDUCTION GEAR

Toshio Kamimura, et al.

UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. MARCH 2007
TRANSLATED BY THE MCELROY TRANSLATION COMPANY

JAPANESE PATENT OFFICE
PATENT JOURNAL
KOKAI UTILITY MODEL NO. SHO 60[1985]-191758

Int. Cl.[4]:	F 16 H 55/24 1/16
Sequence Nos. for Office Use:	8012-3J 7331-3J
Filing No.:	Sho 59[1984]-79728
Filing Date:	May 30, 1984
Publication Date:	December 19, 1985
Examination Request:	Not filed

WORM-TYPE REDUCTION GEAR

[Worm-shiki gensoku-ki]

Designers:	Toshio Kamimura, et al.
Assignee:	Teijin Seiki, Co.

[There are no amendments to this utility model.]

Claim /1*

A worm-type reduction gear characterized by a worm-type reduction gear equipped with a worm wheel, a worm gear meshed with the worm wheel, and a transmission shaft linking the worm gear and an operating handle, transmitting the rotation of the operating handle to the worm, wherein a pressing means is set pressing said worm with a set force in the direction of the worm wheel in tandem

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* [Numbers in right margin indicate pagination of the original text.]

with an elastically deforming deflector set in the transmission between said operation handle and worm wheel.

Detailed explanation of the utility model

Industrial application field

This utility model pertains to a worm-type reduction gear using a worm wheel and a worm gear.

Prior art

Generally, worm-type reduction gears using worm wheels and worm gears are frequently used to precisely adjust the rotation positions of rotating tables of precision measurement equipment and index tables of indexers. The following is required of worm-type reduction gears for such rotary position /2
adjustments. Namely, backlash between the worm wheel and the worm gear should be eliminated in order to raise the precision of the rotary position, and the worm gear, in other words, should always rotate at a fixed torque while the operation handle is rotating because fluctuation in the rotation torque in a single rotation of the operation handle rotating the worm gear will result in excessive rotation of the operating handle, lowering the adjustment precision.

Conventionally, worm type reduction gears, for example, such as shown in Figure 2 have been known for satisfying such requirements. In the same figure, 1 is a housing, and a worm wheel 2 connected to said rotary table, index table, etc., is rotatably supported in this housing 1. Bearing cases 3 and 4 housing bearings 5 and 6 are mounted in separated positions in the housing 1. One end and the /3
other end of a high-rigidity transmission shaft 7 are each rotatably supported by these bearings 5 and 6, and a worm gear 8 meshed with said worm wheel 2 is mounted to the center of this transmission shaft 7. In addition, an operation handle 9 that is manually rotated by an operator is mounted at the one end of the transmission shaft 7 protruding from the bearing 5. The elimination of backlash between this worm wheel 2 and the worm gear 8 as well as adjustment work to make the rotation torque of the operating handle 9 steady are performed by adjusting the insertion of the adjustment screws 12 and 13 pressing the bearing cases 3 and 4 in the direction of the worm wheel 2 in tandem with suitable changes in the thickness and number of shims 10 and 11 inset between the bearing cases 3 and 4 and an inner surface of the housing 1. This is performed by adjusting the insertion of the adjustment screws 12 and 13 pressing the bearing cases 3 and 4 in the direction of the worm wheel 2. In addition, other prior art is known where a ball-and-socket joint is inset between both bearings 5 and 6 and the housing 1, while, on the other hand, adjustment of the bearing 5 side only is possible by shims and adjustment screws.

However, such items have problems in cases where the manufacturing precision of the worm /4
wheel 2 and worm gear 8 is not very high, or when center deviation occurs during mounting of said worm wheel 2 and worm gear 8, and when the thermal expansion rates of the housing 1, worm wheel 2, and worm gear 8 differ, problems occur such as gaps occurring between the teeth of the worm wheel 2

and the teeth of the worm gear 8 generating backlash, or the contact pressure between the worm wheel 2 and the worm 8 changing during a rotation of the worm gear 8 generating fluctuation in the rotation torque of the operating handle 9, making it impossible to achieve the initial objective.

Problems to be solved by the utility model

This utility model solves the conventional problems of backlash generation between the worm wheel and the worm and fluctuation in the torque required to turn the worm gear for a single rotation of the worm gear.

Means to solve the problems

Such problems can be solved by setting a pushing means pushing said worm gear in the direction of the worm wheel at a set force in tandem with setting an elastically deforming deflector in the transmission shaft between said operating handle and worm gear in a worm-type reduction gear equipped with a worm wheel, a worm gear meshed with this worm wheel, and a transmission shaft linking the worm gear and the operating handle, and transmitting the rotation of the operating handle to the worm gear. /5

Operation

Because the worm gear is pressed to the worm wheel at a set force by said pressing means, and the deflector is set in the transmission shaft between said operating handle and the worm, this deflector is elastically deformed along the contour of the worm wheel by this set pressing force. As a result, the worm gear teeth invade and contact between the worm wheel teeth, and the contact pressure thereof is steady even if the manufacturing precision of the worm wheel and worm gear is not very high, if the worm gear mounting adjustment is simplified and center deviation occurs, and if the thermal expansion rates of the housing, worm wheel, and worm gear differ. As a result, it is possible to eliminate backlash between the worm gear and the worm wheel, and to adjust the rotation position of the worm wheel at high precision in tandem with rotating the worm gear and the worm wheel completely as a unit. In addition, because said contact pressure is steady, the required rotational torque is the same with the worm gear and operation handle at any rotational position. /6

Embodiment

The following describes an embodiment of this utility model based on figures.

In Figure 1, 21 is a housing, and this housing 21 rotatably supports a worm wheel 22 linked to for example, a rotating table for precision measurement equipment or an indexing table for an indexer, etc. 23 is a worm gear, and this worm gear 23 is meshed with said worm wheel 22. In addition, 24 is an /7

operating handle, and this operating handle 24 is turned by being manually grasped and turned by an operator. 25 is a transmission shaft transmitting the rotation of said operating handle 24 to the worm gear 23, and this transmission shaft 25 is inset with a square hole 27 for said operating handle 24 in a prism 26 formed at one end of this transmission shaft 25, and is linked to the operating handle 24 by screw washes 29 and nut 30 on screw part 28. In addition, said worm 23 is linked in a unitary fashion to the other end of this transmission shaft 25, and as a result, the worm gear 23 and the operating handle 24 are linked by this transmission shaft 25. The transmission shaft 25 between the worm gear 23 and the operating handle 24 is rotatably supported by the housing 21 via a support means 31. This support means 31 supports at least two points separated in the axial direction of the transmission shaft 25, and as a result, the deflection generated in the transmission shaft 25 when, for example, an external force acts in a radial direction on the operating handle 24, is cut off, governing said deflection transmitted to the worm gear 23 by this support means 31. Although said support means 31 is constituted in this embodiment by two single-row /8
bearings 32 and 33 separated in the axial direction of the transmission shaft, three or more single-row bearings, one or more multiple-row bearings, or needle bearings (the number of support points for linear support is unlimited) may be used. 34 and 35 are collars arranged between the bearings 32 and 33. A deflector 36 of small axial diameter is set in the transmission shaft 25 between said worm gear 23 and the operating handle 24, or between the worm gear 23 and the support means 31, and this deflector 36 deflects by elastic deformation when a radial external force acts on, for example, the other end of the transmission shaft 25. 41 is a slider supported in a slideable manner in the housing 21, and this slider 41 can move in the radial direction of said transmission shaft 25. An arm 42 is formed as a unit at the side adjacent to the transmission shaft 25 of the slider 41, and the other end of the transmission shaft 25 is rotatably supported by this arm 42 via the bearing 43. 44 is a cover fixed to said housing 21, and an adjustment screw 46 with a bearing 45 is fixed by a screw-in lock nut 47 to the cover 44. A spring 48 9
that energizes the slider 41 toward the worm wheel 22 is inset between said bearing 45 and slider 41, and as a result, the worm gear 23 is pressed by a fixed elastic force toward the worm wheel 22. Said slider 41, adjustment screw 46, and spring 48 comprise the pressing means 49 as a whole. Furthermore, 50 is a cover fixed to the housing 21.

Next, we will describe the action of an embodiment of this utility model.

First, when adjusting the rotation position of a rotary table, etc., the operating handle 24 is grasped by hand, and turned thereafter. The rotation of this operating handle 24 is transmitted to the worm gear 23 via the transmission shaft 25, and the worm wheel 22 is turned by the rotation of this worm gear 23, adjusting the rotation position of the rotary table, etc. At this time, the spring 48 applies a fixed elastic force to the other end of the transmission shaft 25 via the slider 41. As a result, the deflector 36 supported by being held at one end by the support means 31 is deflected by elastic deformation of the one end, and the worm gear 23 is pressed at a fixed force by the worm wheel 22. As a result, the teeth of /10

the worm gear 23 and the worm wheel 22 contact precisely, and backlash between these is eliminated. In addition, because the worm gear 23 contacts the worm wheel 22 at a fixed contact pressure, the torque required for rotation of the worm gear 23 is steady, and as a result, the rotation torque to be added to the operating handle 24 also is steady. During such adjustment of the rotational position, although the transmission shaft 25 is deflected by an external force when an external force in the radial direction of operating handle 24 is added, this deflection is cut off by the support means 31, and is not transmitted to the other end by the support means 31. Therefore, there is no change in the contact pressure on the worm wheel 22 from the worm gear 23 by such an external force. Furthermore, in cases where the pressure force by said spring 48 changes, the screw-in amount of the adjustment screw 46 can be changed.

Figures 3 and 4 show another embodiment of this utility model. In the above embodiment, although the pressure force of the pressing means 49 is transmitted to the worm gear 23 via the transmission shaft 25, in this embodiment, the pressure force of the pressing means 60 is directly applied to the worm gear 23. In other words, a pair of brackets 51 and 52, separated in the axial direction of the /11
transmission shaft 25, is formed as a unit on the side adjoining the transmission shaft 25 of the slider 41, and both ends of a pair of pins 53 and 54 parallel to the axial line of the worm gear 23 are mounted to these brackets 51 and 52. Rollers 55 and 56 are rotatably supported by these pins 53 and 54, and these rollers 55 and 56 are mutually separated at a fixed angle on the outer circumference of said worm gear 23, and contact in a rolling manner. As a result, the elastic force of the spring 48 is directly applied to the worm gear 23 via the slider 41 and the rollers 55 and 56. The remaining constitution and actions are the same as previously stated.

In the embodiments given above, although the acting direction of the elastic force of the spring 48 was the radial direction of the worm gear 23, such an elastic force can be added to the transmission shaft 25 or the worm gear 23 after directional conversion to the radial direction of the worm gear 23 using a link, etc., in tandem with the acting direction of the elastic force of an elastic body such as a spring etc., being in a direction parallel to the axial direction of the worm gear 23 and the transmission shaft 25.

Effect of the utility model /12

As described above, according to this utility model, backlash between the worm wheel and the worm gear can be reduced, and, the torque necessary to rotate the worm gear can be made steady.

Brief description of the figures

Figure 1 is a cross section showing an embodiment of this utility model, Figure 2 is a cross section of a conventional worm-type reduction gear, Figure 3 is a corss section of the vicinity of the worm gear showing another embodiment of this utility model, and Figure 4 is an A-A corss section of Figure 3.

22 Worm Wheel

23 Worm Gear

24 Operating Handle

25 Transmission shaft

36 Deflector

49, 60 Pressing means

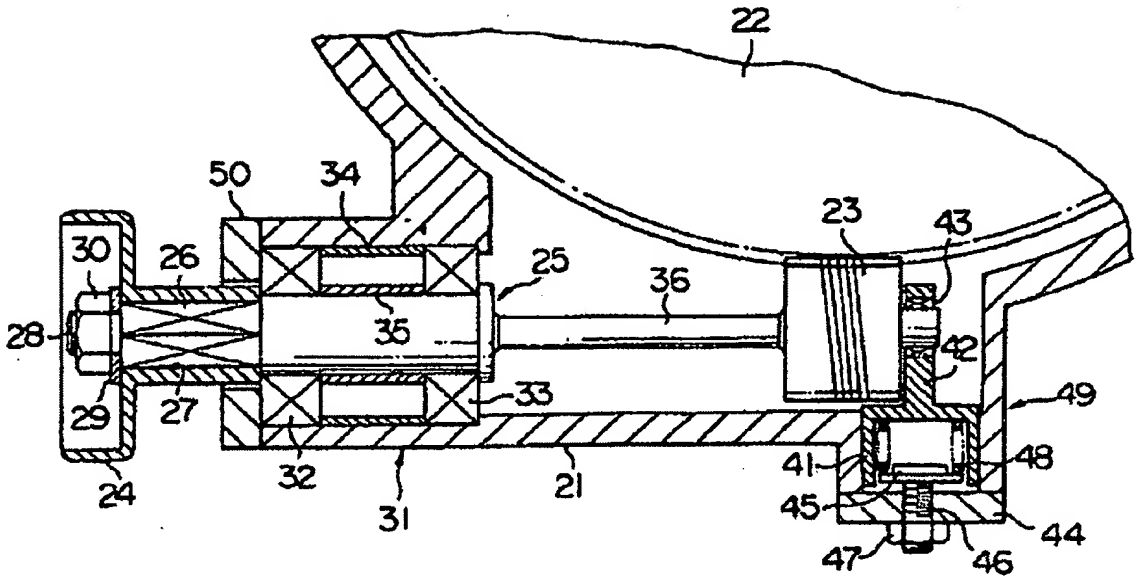

Figure 1

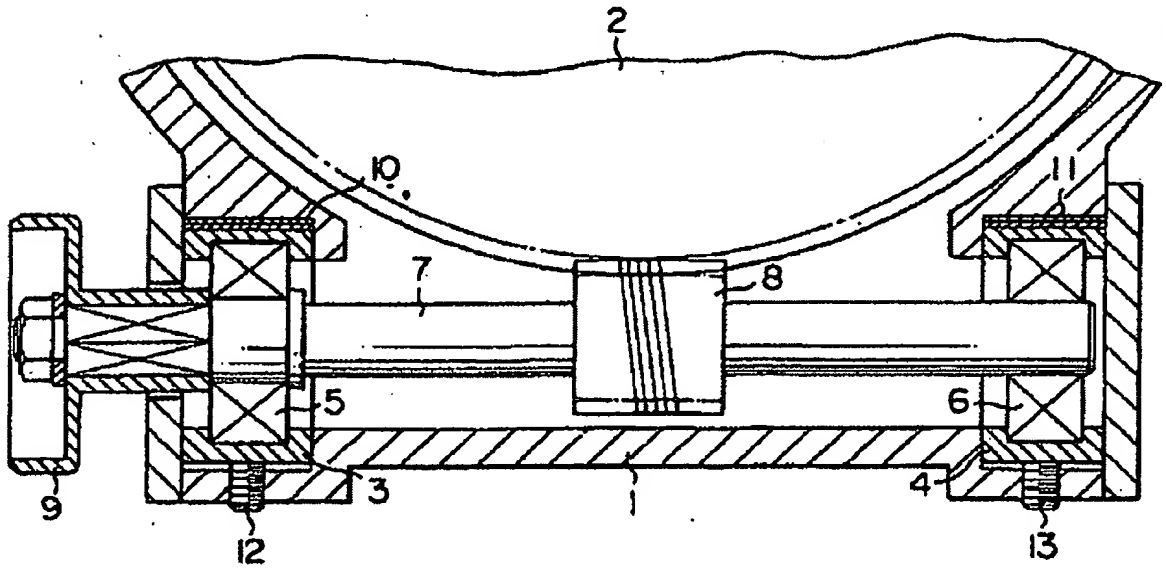

Figure 2

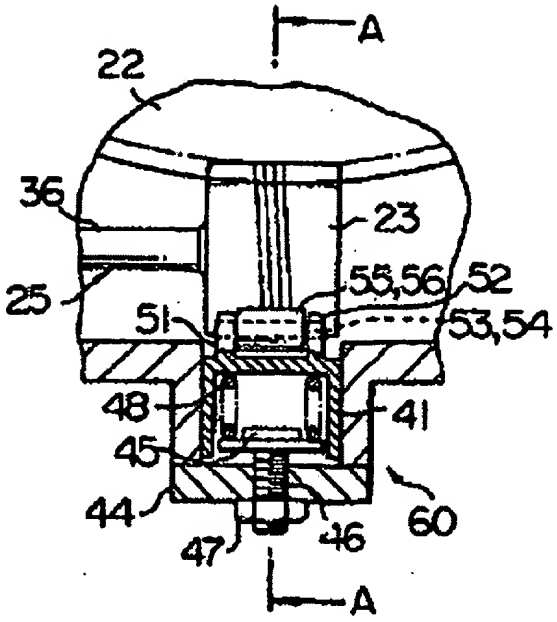

Figure 3

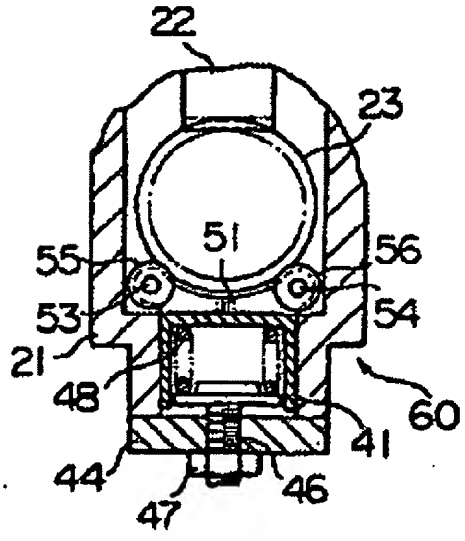

Figure 4